

WHAT IS CLAIMED AS NEW AND DESIRED TO BE SECURED BY LETTERS
PATENT OF THE UNITED STATES IS:

1. A spin-tunnel transistor, comprising:

an emitter;

5 a collector formed adjacent to the emitter;

a base formed between the emitter and the collector and having a magnetization pinned layer of ferromagnetic material, a magnetization free layer of ferromagnetic material and a nonmagnetic layer between the magnetization pinned layer of ferromagnetic material and the magnetization
10 free layer of ferromagnetic material, the magnetization pinned layer having a magnetization substantially fixed in an applied magnetic field, the magnetization free layer having a magnetization substantially free to rotate under the applied magnetic field, and the nonmagnetic layer decoupling exchange coupling between the magnetization free layer of ferromagnetic
15 material and the magnetization pinned layer of ferromagnetic material; and
a tunnel barrier layer of antiferromagnetic material formed between the magnetization pinned layer of ferromagnetic material and the emitter or between the collector and the magnetization pinned layer of ferromagnetic material and provided with an exchange coupling with the adjoining
20 magnetization pinned layer of ferromagnetic material, the magnetization of the magnetization pinned layer of ferromagnetic material being fixed by the exchange coupling between the magnetization pinned layer of ferromagnetic material and the tunnel barrier of antiferromagnetic material.

2. A spin-tunnel transistor of claim 1, wherein the antiferromagnetic material comprises cobalt oxide, iron oxide or nickel oxide.

3. A spin-tunnel transistor of claim 1, further comprising a dielectric layer of nonmagnetic material formed in contact with the tunnel barrier layer of antiferromagnetic material.

4. A spin-tunnel transistor of claim 1, wherein the magnetization pinned layer contains a metal selected from the group consisting of Fe, Co, Ni, or an alloy containing the metal, and the tunnel barrier layer of antiferromagnetic material contains an oxide of the metal.

5. A spin-tunnel transistor of claim 1, wherein the tunnel barrier layer of antiferromagnetic material is formed between the magnetization pinned layer and the emitter, and the emitter has a semiconductor surface contacting the tunnel barrier layer of antiferromagnetic material.

6. A spin-tunnel transistor of claim 1, further comprising another tunnel barrier layer of nonmagnetic dielectric material formed in contact with the magnetization free layer of ferromagnetic material.

7. A magnetic reproducing head, comprising:
a spin-tunnel transistor comprising,
an emitter,

a collector formed adjacent to the emitter,

a base formed between the emitter and the collector and having a magnetization pinned layer of ferromagnetic material, a magnetization free layer of ferromagnetic material and a nonmagnetic layer between the magnetization pinned layer of ferromagnetic material and the magnetization free layer of ferromagnetic material, the magnetization pinned layer having a magnetization substantially fixed in an applied magnetic field, and the magnetization free layer having a magnetization substantially free to rotate under the applied magnetic field, and

a tunnel barrier layer of antiferromagnetic material formed between the magnetization pinned layer of ferromagnetic material and the emitter or between the collector and the magnetization pinned layer of ferromagnetic material and provided with an exchange coupling with the adjoining magnetization pinned layer of ferromagnetic material, the magnetization of the magnetization pinned layer of ferromagnetic material being fixed by the exchange coupling between the magnetization pinned layer of ferromagnetic material and the tunnel barrier of antiferromagnetic material.

8. A magnetic reproducing head of claim 7, comprising:

an electric field effect transistor electrically coupled to the collector ,
and

the spin-tunnel transistor and the electrical field effect transistor formed on a same substrate.

9. A magnetic reproducing head of claim 8, further comprising a magnetic flux guide magnetically coupled with the magnetization free layer.